THE DISTRIBUTION OF THREE SPECIES OF ENCHYTRAEIDAE IN DIFFERENT SOILS

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Introduction

Quantitative ecological studies on the Family *Enchytraeidae* (Order *Oligochaeta)* has been restricted because of lack of satisfactory extraction methods, although several workers in the last hundred years have described enchytraeid species from varied habitats. Recently, suitable extraction techniques have been developed by NIELSEN (1952) and O'CONNOR (1955). These techniques, together with a review of the taxonomy of the group by NIELSEN and CHRISTENSEN (1959, 1961) have greatly facilitated quantitative studies on populations of Enchytraeidae and their species content.

The present paper describes the vertical distribution of three common species of Enchytraeidae in four different soil habitats. These species, *Cognettia sphagnetorum* (VEJDOVSKY) 1877, *Marionina simillima* NIELSEN and CHRISTENSEN 1959 [1]), and *Achaeta eiseni* VEJDOVSKY 1877 occur in several habitats and four of these, in north England, were selected for study. Each habitat was sampled during February and March 1962.

1) Permanent pasture.
2) *Fagus silvatica* litter, 'mull' soil.
3) *Pinus sylvestris* litter. 'mor' soil.
4) *Nardus stricta* grassland.

Cores of soil 10 cm^2 in surface area and 6 cm deep were taken as sample units, 15 units being taken at each locality. The cores were cut horizontally into four equal layers 1.5 cm deep, and each of the subcores were extracted separately. A modified Baermann funnel, as developed by NIELSEN (1952)

[1]) I am not fully satisfied that this species is *M. simillima* but possibly an undescribed closely related species. However I am confident that only one species of *Marionina* was involved in this study.

and O'CONNOR (1955), was used for extraction. The extraction lasted three hours and in this time the temperature of the surface of the sample was raised by 43 degrees (12 — 55°C) and the base by 33 degrees (12 — 45°C) but the water at the base of the funnel by only 5 degrees. The extracted worms were kept alive at 5°C in tap water for 24 hours. This was found to be sufficient time for the anterior portion of the gut to clear to facilitate identification of the animals. The individual worms were placed under a cover slip on a slide and identified using the discription of NIELSEN and CHRISTENSEN (1959, 1961).

Species composition

The total population and the species content of the four areas are shown in Table 1. The *Pinus* and *Fagus* litter had almost identical densities while those of the permanent pasture and the Nardus grassland were higher. During this study ten species were found, but only three of these occurred in all four localities; *Cognettia sphagnetorum*, *Marionina simillima*, and

TABLE 1. The numbers per square meter and the percentage species composition of the four soil habitats

Species	Pinus litter		Fagus litter		Permanent pasture		Nardus grassland	
	No./m²	% of total	No./m²	% of total	No./m²	% of total	No./m²	% of total
C. sphagnetorum . .	34,640	42	26,400	33	58,960	54	113,700	70
M. simillima	44,400	55	15,000	19	39,900	36	21,200	15
A. eiseni	540	1	16,500	21	10,700	10	3,300	2
Mesenchytraeus glandulosus	1,700	2						
Sp. A.			21,700	27				
C. glandulosa							2,000	1
C. cognettii							12,330	8
Cernosvitoviella atrata							2,940	2
Mesenchytraeus sanguineus							2,900	2
Total number per m² and standard error	81,280 ± 2,600		79,600 ± 8,700		109,560 ± 4,500		158,370 ± 13,700	

TABLE 2. The numbers and species of *Enchytraeidae* extracted from 15 sample units from each of the four sample sites

	Depth in cm				Total of each species per sample
Pinus litter	0—1.5	1.5—3	3—4.5	4.5—6	
C. sphagnetorum . . .	374	85	36	22	517
M. simillima	279	305	73	8	665
A. eiseni	0	0	0	8	8
Mesenchytraeus glandulosus	24	0	0	0	24
Total	677	390	109	38	1,214
Fagus litter					
C. sphagnetorum . . .	276	91	22	5	394
M. simillima	63	136	21	4	224
A. eiseni	54	89	62	41	246
Sp. A.	92	203	23	6	324
Total	485	519	128	56	1,188
Permanent pasture					
C. sphagnetorum . . .	755	92	24	9	880
M. simillima	467	102	27	0	596
A. eiseni	78	48	30	4	160
Total	1,300	242	81	13	1,636
Nardus grassland					
C. sphagnetorum . . .	289	819	453	117	1,678
M. simillima	39	265	44	0	348
A. eiseni	0	13	34	0	47
C. glandulosa	5	24	0	0	29
C. cognettii	12	158	17	0	187
Cernosvitoviella atrata .	0	28	18	0	46
Mesenchytraeus sanguineus	0	0	36	8	44
Total	345	1,307	602	125	2,379

Achaeta eiseni. The seven other species found were: *Mesenchytraeus glandulosus* (LEVINSEN) 1884, in *Fagus* and *Pinus* litter; *Cognettia cognettii* (ISSEL) 1905, in *Fagus* litter and *Nardus* grassland; a species (Sp. A.), which has not yet been identified, formed 27 % of the population in the *Fagus* litter and had a vertical distribution similar to that of *Marionina simillima*. *Mesenchytraeus sanguineus* NIELSEN and CHRISTENSEN, 1959; *Cernosvitoviella atrata* (BRETSCHER) 1903; and *Cognettia glandulosa* (MICHAELSEN) 1888 were found in NARDUS grassland. A *Fridericia* sp. (immature) was found in *Pinus* litter.

Of the three widespread species, *C. sphagnetorum* and *M. simillima* were the most abundant. The percentage species composition of the four areas differed (Table 1). *C.sphagnetorum* formed 70 % of the total population in *Nardus* grassland but only 33 % in *Fagus* litter. *M. simillima* was most abundant in *Pinus* litter where it formed 55 % of the population while in *Nardus* grassland it formed only 15 % of the total. *A. eiseni* nowhere formed more than 21 % of the total population.

Vertical distribution

The vertical distribution of all species grouped together and expressed as the percentage of the total numbers in each habitat is shown in Table 3. The *Fagus* litter has similar densities of enchytraeids in the top two layers (0 — 3 cm), in contrast to the superficial distribution in permanent pasture (0 — 1.5 cm), the intermediate situation in *Pinus* litter, and the highest proportion in the 1.5 — 3 cm zone in *Nardus* grassland.

TABLE 3. The vertical distribution of all species grouped together, expressed as the percentage of the total numbers in each habitat

	Depth in cm			
	0—1.5	1.5—3	3—4.5	4.5—6
Permanent Pasture	79	15	5	1
Pinus Litter	56	32	9	3
Fagus Litter	41	43	11	5
Nardus Grassland	15	55	25	5

In all four sample sites, the vertical distribution of each of the three species showed the same trends with *C. sphagnetorum* occuring most abundantly in the surface zone, *A. eiseni* occuring deepest, and *M. simillima* intermediate. In permanent pasture, where all of the species tended to occur near the surface, there is a significantly higher proportion of *C. sphagnetorum* in the surface zone (0 — 1.5 cm) than *M. simillima* ((χ^2 = 13.80, d.f. = 1, P = <.01). In *Nardus* grassland, where the highest numbers of *Enchytraeidae* occur in the 1.5 — 3 cm zone, the proportion of *M. simillima* in the 0 — 3 cm layers is significantly greater than the proportion of *C. sphagnetorum* χ^2 = 62.09, d.f. = 1, P = <.01). This difference in vertical distribution is still apparent when the relative abundance of each species in each layer is considered. *A. eiseni* becomes relatively more abundant below 3 cm and the proportions of *M. simillima* and *C. sphagnetorum* decrease. *M. simillima* tends to be most abundant at 1.5 — 3 cm and *C. sphagnetorum* to have its greatest proportions in the surface layer. But individuals of *C. sphagnetorum* occur in all four vertical zones while *M. simillima* and *A. eiseni* are absent from some of the zones at certain stations. *M. simillima* was not found in the 4.5 — 6 cm layer of *Nardus* grassland and permanent pasture. *A. eiseni* occurred only in the 4.5 — 6 cm layer of *Pinus* litter and the 1.5 — 4.5 cm layers of *Nardus* grassland. This seems to indicate that the last mentioned two species are more exacting in their environmental requirements than *C. sphagnetorum*.

Summary

In this study the vertical distribution of three common species, (*Cognettia sphagnetorum* (VEJDOVSKY) 1877, *Marionina simillima* NIELSEN and CHRISTENSEN 1959, and *Achaeta eiseni* VEJDOVSKY 1877) of the Family *Enchytraeidae* (Order *Oligochaeta*) in four different soil habitats has been studied. It has been found that there is a tendency for the three species to inhabit different layers of the soil. *Cognettia sphagnetorum* occuring in the surface layer, *Achaeta eiseni* in the deeper layers and *Marionina simillima* intermediate.

References

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Discussion

Mrs. J. A. SPRINGETT: A second series of samples was taken in August, and the same relative distribution of the 3 species was observed.

F. B. O'CONNOR: I was studying on similar species in coniferous forest soil. In drought I found no vertical migration. Those in the upper layer die sooner than those of lower layers. This is related to the type of soil profile, if there is a deep humus layer they can migrate down in drought, but if the physical properties at the lower layers prevent migration, they die.

G. ZACHARIAE: This is the same as my observations in thick layers of raw humus. In soil profiles with a deep layer of raw humus there is sometimes a certain migration of moisture. The resistance to wetting is in these cases very great, so that the rain water after a dry period penetrates very slowly downwards, while the surface is already drying out again. Thus the Enchytraeidae are forced to migrate with the moisture which is very important and determines their activity in litter decomposition and humus formation.

W. G. HALE: I think it is difficult to differentiate between vertical migration and differential mortality. In Collembola I have shown that in summer and winter there is a greater proportion in the 3—6 cm layer (as compared with the 1—3 cm layer) than in spring and autumn. Unless all individuals can be aged, vertical migration cannot be demonstrated with certainty.